By John A. Tirpak, Senior Editor February 1998

FOR the last seven years, Air Force leaders have talked up precision weapons. They have noted how accurate they will be, how effective, and how inexpensive. In their speeches--dotted with references to how many aircraft have been retired--the punch line always was precision weapons. The awesome new munitions are coming, they said, and they will be the equalizers.

USAF in the wake of the Gulf War began to mothball large numbers of combat aircraft, in part to finance the development and production of these new weapons. Now, it looks like USAF's gambit is going to pay off. Tests of new munitions suggest that they will work as advertised, and it seems that, in a future war, USAF will be able to destroy as many targets as it did in the Gulf War--and as quickly--with about half the airplanes.

These munitions come in a bewildering array of shapes and sizes, however. Each is optimized for a particular "target set." Each is designed to work at a particular distance from a target, based on postulated air defenses that could range from token to lethal.

In addition, each munition occupies its own niche in a notional air campaign but has the flexibility to be applied to other missions. Some are adapted "legacy systems" souped up with new sensors, warheads, and sometimes rockets to bridge the gap until the most potent new missiles come on line. Others are breaking new ground in bomb technology.

You start with your expensive, standoff, complex weapons, said Col. Dennis Miner, Precision Engagement Division chief in USAF's Directorate for Operational Requirements. "Once you beat down the threat and gain air superiority, you can go to what we call a 'level of effort' weapon."

AGM-86B CALCM

Longest legged of the precision munitions is the conventionally armed Air Launched Cruise Missile. In recent years, strategic arms treaties rendered a portion of the AGM-86B nuclear ALCM inventory "excess" to requirements. When that happened, the Air Force contracted with Boeing to swap out their nuclear warheads for conventional ones.

At the same time, the conversion added Global Positioning System capability to the ALCM's terrain-following system, making for a good weapon with which to attack targets at great distances, obviating the need to send aircrews over enemy territory.

USAF has used CALCMs twice. The first instance came on opening night of the Gulf War, when CALCM-carrying B-52 bombers from Barksdale AFB, La., attacked Iraq. In fact, CALCMs were the first

weapons released in the war. They struck power stations, command-and-control nodes, and other targets. The second use of CALCMs came in 1995, when they were fired as part of a punitive cruise missile strike against Iraq for its noncompliance with cease-fire requirements.

Under mutually agreed upon arms-control counting rules, the CALCMs are still regarded as nuclear weapons and are subject to limitations. About 200 ALCMs have been converted, and another 200 are "available" for conversion, Miner said. The exact size of the CALCM inventory is classified, but "the CALCM requirement will continue to outstrip ALCM availability," Miner added.

CALCM is being fitted with a differential GPS guidance kit giving it accuracy to within 13 meters of the precise aim point. This Block II version would have an accuracy comparable to that of a Laser-Guided Bomb but would have a range of hundreds of miles compared to a few miles only for the LGB. The Air Force is also studying the possibilities of using a British shaped-charge, which would give the CALCM a deep-penetrating, bunker-busting capability.

Only specially equipped B-52Hs at Barksdale are equipped to carry and launch the CALCM.

Joint Air to Surface Standoff Missile

CALCMs partly fill a gap in capability that was left when the Tri-Service Standoff Attack Missile program was canceled in 1994. TSSAM was to have been the first Joint service stealth missile, but problems in its management both at the Pentagon and at the contractor forced its termination.

The search for a way to replace the TSSAM capability led to a system called the Joint Air to Surface Standoff Missile. JASSM occupies the "high end" of the new munitions mix, Miner said.

According to the Air Force, a number of autonomous JASSMs, launched early in an air campaign, could fly undetected to attack numerous centers of gravity in enemy territory and bring down command-and-control networks and power grids, as well as hardened bunkers. It is the most expensive of the new weapons. For that reason, JASSM would likely only be used until the US achieved air supremacy in the battlespace.

"One of the things that JASSM brings to the table is that you don't have to wait for air defenses to be completely knocked down before you start attacking other critical targets other than air superiority-type targets," said Miner, who added he was referring to "command-and-control nodes, infrastructure, ... targets you would attack in the opening days of the war."

Miner explained, "We call that parallel warfare, as opposed to a roll-back campaign, where you roll back the defenses little by little to where you can ... reach those places." With JASSM, "you have the standoff range where you can attack strategic targets without subjecting your forces to threats."

Ironically, JASSM as now envisioned will be "a significant improvement" over TSSAM, according to Harry E. Schulte, Air Force's weapons program executive officer. This is true because of technological advances that have taken place since TSSAM was designed in the mid-1980s. Also, JASSM's price may be as low as a fourth of what TSSAM would have cost. Acquisition reforms that set desired results goals--not performance specifications--helped drive the cost down, Schulte said.

He explained, "We told [the contractors], 'Here's the target set we want to kill, ... and we want to kill it with as few missiles as possible. ... Go to it.' "

Both competing versions of JASSM--one designed by Boeing, one by Lockheed Martin--would use a combination of GPS navigation and inertial navigation, coupled with an autonomous infrared seeker, and both have a 1,000-pound-class warhead. If the program proceeds as planned, the first operational missiles will be available in Fiscal 2001.

The JASSM is one of the most hotly debated weapons in the new munitions mix, however.

The Navy would prefer to fill the requirement by using a variant of its long-established Harpoon antiship missile--called the Standoff Land Attack Missile-Expanded Response. However, the Air Force has balked; it complains that SLAM-ER won't reach far enough or be stealthy enough. "We have a disagreement with the Navy on this," said Schulte, "but we just don't think it will meet the [operational requirements document]."

"Depending on whose calculation you believe, SLAM-ER either barely misses the range requirement or barely makes the range requirement," said Schulte. When it comes to low observability, the story is much the same, he said. The Navy feels that SLAM-ER is "good enough." He added, "That's a quote from them. We are not willing to settle for 'good enough.' "

The Air Force program has encountered fiscal problems. Congress nearly halved JASSM funding this year, requiring DoD to review alternatives. Schulte attributed the Congressional action to the Navy's promotion of SLAM-ER as a cheap alternative to JASSM, but he insisted that the JASSM program "shows every promise" of producing a weapon of twice the range and actually a lower cost than SLAM-ER. Moreover, SLAM-ER is "four inches too big" to fit in the B-1B weapons bay, Schulte said, requiring modifications and testing the Navy hasn't included in its estimates.

"Our belief is that JASSM is about twice as effective as SLAM[-ER]," he added. "It will be cheaper to buy, and it will clearly be cheaper to support, because it will have a 15-to-20-year warranty." Moreover, SLAM-ER wouldn't be able to take on some of the required targets because its warhead would be between half and a third as powerful as the JASSM's.

It would be a mistake to drop the JASSM program, Schulte concluded.

The JASSM will "take out key targets in the first few nights of the air campaign," Schulte said. "You have to do that with something if you're then going to get in there" and attack with cheaper weapons as the air campaign progresses.

The operating requirements for JASSM are classified, but it should be able to attack targets 100 miles distant; such a range brings it well within the limitations imposed by ratified arms-control treaties.

The JASSM could be carried by all Air Force bombers, as well as the F-16, and fit checks have been done with every aircraft in the attack fleet. To get low prices from the two contractors, the Air Force has promised to buy at least 2,400 JASSMs over a 10-year period, but final inventory requirements for USAF alone range from 3,300 to 10,000, depending on which study is used as the requirement driver and which assumptions are made.

While the Air Force is waiting for JASSM to arrive, it is depending on the AGM-130 and the AGM-142, which Miner described as "interim" weapons for the standoff mission against hardened targets.

The AGM-130 is a rocket-powered version of the GBU-15 2,000-pound glide bomb, while the AGM-142--also known as Have Nap--is a monster of a powered bomb that uses electro-optical guidance. Both weapons have a range of 50 to 60 miles, well short of the planned range of the JASSM.

Joint Standoff Weapon

As Air Force aircraft draw closer to enemy air defenses, the next munition of choice will be the Joint Standoff Weapon.

A weapon that will be used by both the Air Force and the Navy, JSOW is managed by the Navy and has been in development since the early 1990s. A handful are already available at sea, left over from a highly successful test

program.

The JSOW is a stealthy glide bomb that will be carried by all Navy and Air Force strike aircraft. Using both GPS and INS for guidance--as well as an imaging infrared version with a data link in one Navy version--the JSOW will probably comprise much of the first round of attack against enemy air defenses. Depending on the altitude at which it is released, JSOW can glide 40-60 miles and either dispense submunitions or dive onto its target with a unitary warhead.

Destroying known air defense sites with JSOWs would make it easier to get closer to enemy territory where High Speed Anti-Radiation Missiles, similar to those used in the Gulf, could be employed. JSOW will cost less than HARM.

The JSOW--built by Raytheon TI Systems--can be fitted with a special version of the anti-armor submunition called the Sensor Fuzed Weapon. This submunition dispenses smaller projectiles that fire discriminately at targets on the ground. Under best-case conditions, a single SFW could knock out a column of 40 tanks; the anti-air defense version has submunitions better suited to the generally "softer" nature of air defense systems.

The JSOW replaces the troublesome Walleye and Skipper glide bombs in the Navy. That service will rely on the stealthy JSOW to be a pathfinder for its nonstealthy attack aircraft.

After outer air defenses have been suppressed, JSOW will allow US warplanes to get closer to interior targets and release without coming within range of tough point defenses. The B-2, for example, will use JSOW to make surprise attacks from a distance, without ever exposing the airplane to a "lucky shot" from the ground.

USAF and Navy plan to acquire over 24,000 JSOWs--16,000 will be dispenser models--4,200 of which will carry the Sensor Fuzed Weapon and 7,800 a unitary warhead.

Wind-Corrected Munitions Dispenser

Once enemy air defenses have been largely suppressed and air supremacy achieved, the Air Force will be able to use the Wind-Corrected Munitions Dispenser. A tail kit which fits on existing dispensers, the WCMD will be able to correct for windage on its own, allowing the warplane employing it to avoid overflying the target. The weapon is "told" where it is before release, then uses inertial guidance to determine where it should make impact. At a 40,000 feet release, the WCMD will be able to steer to a target area about nine miles away, and about two to three miles cross range, or away from the flight path of the airplane itself. At 20,000 feet, its down-range distance diminishes to four to five miles and cross range to one to two miles. At 10,000 feet, the WCMD can guide a dispenser two to three miles down range and about a mile to either side of the airplane's flight path.

The WCMD is planned to fit on the CBU-87 Combined Effects Munition, the CBU-89 Gator air-delivered mine, and the CBU-97 Sensor Fuzed Weapon. Production starts in 1999.

Schulte noted that, because the WCMD delivers an "area" weapon, in which a precision hit is not needed, it wasn't necessary to buy a more expensive guidance package for it. For this reason, a common guidance kit for the WCMD and Joint Direct Attack Munition was not pursued.

All USAF strike aircraft except the B-2 would carry the WCMD. The B-2 will focus on hitting higher-value point targets requiring its stealth and range.

Joint Direct Attack Munition

The largest program among all the precision weapons will be the Joint Direct Attack Munition. The JDAM came about out of frustration: During the Gulf War, US pilots sometimes had to return from a mission with their ordnance still on the racks, due to bad weather over the target. Especially where high precision was

required--such as in the use of Laser-Guided Bombs--a weather-obscured target meant a wasted mission.

The JDAM solves the problem by equipping each bomb with a tail kit providing GPS guidance. The resulting accuracy will put the JDAM within 39 feet of its intended target--almost as good as a Laser-Guided Bomb and without having to overfly the target or wait for clear weather.

The JDAM has performed well in tests, and an early version is already equipping B-2 bombers at Whiteman AFB, Mo. All attack aircraft except the F-117 will use JDAM, and a special version of the bomb will give the F-22 air superiority fighter a secondary ground-attack role. The B-52 will be next to get JDAM, later this year.

The JDAM comes in two versions: 1,000 and 2,000 pounds.

Boeing builds the JDAM--having acquired the program when it bought McDonnell Douglas--and Schulte holds the program up as a model of acquisition reform. Originally estimated to cost around $40,000 a round, JDAMs will now be bought for less than a quarter of that. Considering that the Air Force and Navy are buying over 87,000 tail kits--62,000 for USAF and about 25,500 for the Navy--the resultant savings is over a billion dollars.

Much of the price decrease is due to progress in reducing the size and cost of GPS receivers. At the time of the Gulf War, GPS-guided munitions were so expensive and limited in number that they were a top secret. Today, with handheld GPS receivers available in most electronics stores, the cost of precision location has dropped enormously.

Laser-Guided Bombs

Finally, the Air Force will continue to buy Laser-Guided Bombs for those targets that still demand pinpoint accuracy. However, the advent of JDAM means that not nearly as many LGBs will be needed as originally planned.

The LGBs work by following the reflected light of a laser beam, which can either be shone on the target by the aircraft itself, by another airplane, or by ground troops with a handheld laser designator.

Over 36,000 Laser-Guided Bombs are in the inventory today, of five different varieties, and USAF is planning to buy about 800 more. Because so many more USAF aircraft of today are capable of using LGBs than during the Gulf War, the fleet's ability to destroy point targets has increased in spite of the fleet's overall reduction in size.

Despite the tremendous improvements in accuracy offered by the new precision munitions, the Air Force is not resting on its laurels. The service is exploring new high explosives which, at half to one-quarter the weight of existing bombs, could deliver as much destructive force. Coupled with even more precise targeting, more targets could be killed per aircraft, per sortie, since each airplane could carry more bombs. This in turn would put even more distance between the Air Force and the days when it took numbers of airplanes to destroy a target. Now, it is numbers of targets destroyed per airplane, per sortie.

The intent of the Miniature Munitions Technology Demonstration, Schulte said, is to refine the JDAM tail kit to make it more accurate and put it on a 250-pound penetrator bomb.

"We found it to be pretty effective" in tests, he said.

"With improved accuracies, you could have a smaller bomb. With a smaller bomb, you can carry more of them on an aircraft, and the logistics tail associated with them is smaller."

Analyses have shown that "about 60 percent of target set you would go after with JDAM [is] vulnerable to a small bomb. So there are platforms like the F-22 and the F-117 ... where you would be better off if you could

carry more, smaller bombs."

The biggest technical challenge of the program, he thinks, would be the rack that would fit inside an F-117 or F-22, not the bomb. Even that, he thinks, would not be a "major technological challenge."

"We have time" to explore the concept, Schulte noted. "We could maybe ... put it on the F-117 by 2004 and maybe on the F-22 by 2007."

Underlying such a bomb program--still unfunded for development--is the persistent question of "Could we get more kills per sortie?" Schulte said. On the F-117, which only has racks capable of carrying two bombs right now, "maybe we could get five targets in a sortie, instead of two."